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In the March number will appear:

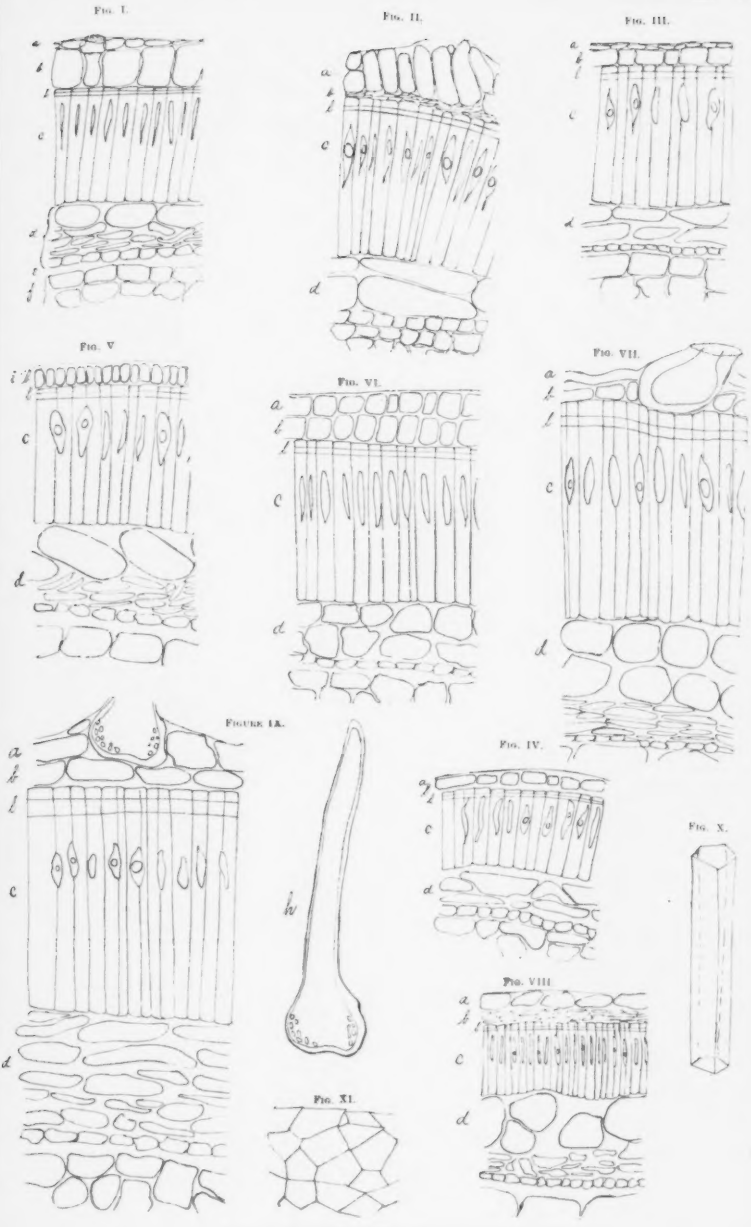
Flowers and insects. VII, by CHARLES ROBERTSON, *Carlinville, Ills.*

Evolution in methods of pollination, (concluded) by MISS ALICE CARTER, *Ithaca, N. Y.*

Enumeration of Kansas mosses, by F. RENAULD and JULES CARDOT, *Monaco*, and *Stenay, France.*

F. W. Anderson, a biographical sketch, with portrait, by F. D. KELSEY, *Helena, Mont.*

Together with the usual shorter articles, reviews, summaries, news, notes, etc.



ROLFS on SEED COATS

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BOTANICAL GAZETTE

FEBRUARY, 1892.

The seed coats of Malvaceæ.*

P. H. ROLFS.

(WITH PLATE III.)

Much attention has been given to the rich field of development and structure of seed coats. Most of the work has been done by European investigators. American botanists are rapidly taking up the work, and are studying not only the seed coats but the entire anatomical plant structure.

Of the investigators who have given the matter of seed coats attention, Gaertner,[1] Bischoff,[2] Schleiden and Vogel,[3] Harz,[4] Nobbe,[5] Sempolowski[6] and Lohde[7] may be mentioned. H. Godfrin,[8] who has examined the seed coats of thirty-four orders, finds that while the structure of the seed coats is useful in some directions, it is of no taxonomic value.[9] Bachmann,[10] in his paper on the development and structure of seed coats of Scrophulariaceæ, says that the microscopic characters of seed coats are of little value from a systematic standpoint.

In the order of presenting the different genera and species of this paper Gray's Manual has been followed. In all twenty-two genera and thirty-four species were studied. The gen-

*A thesis in Department of Botany, Iowa Agricultural College.

[1] GAERTNER: De Fructibus et Seminibus Plantarum, 1791.

[2] BISCHOFF: Handbuch der bot. Terminologie und Systemkunde, 1883.

[3] SCHLEIDEN and VOGEL: Ueber das Albumen insbesondere der Leguminoseen.

[4] HARZ: Landwirthschaftliche Samenkunde, Berlin, 1885.

[5] NOBBE: Handbuch der Samenkunde, Berlin, 1876.

[6] SEMPOLOWSKI: Ueber den Bau der Schalen landwirthschaftlich wichtiger Samen, 1874.

[7] LOHDE: Ueber die Entwickelungsgeschichte und der Bau einiger Samenschalen. Inaugural dissertation, Naumburg, 1874. p. 34.

[8] GODFRIN: Etude histologique sur les téguments seminaux des angiospermes. Nancy, 1880. pp. 112, 5 plates.

[9] L. H. PAMMEL: On seed coats of the genus Euphorbia. Proc. Am. Assoc. Adv. Sc. vol. XXXIX. 1890. p. 328.

[10] BACHMANN: Die Entwickelungsgeschichte und der Bau der Samenschalen der Scrophularineen. Halle, 1880. pp. 179, 4 plates.

eral structure of this order is very characteristic. There are minor differences only in the different species of the same genus and non-essential variations in the different genera.

The seeds of Malvaceæ are anatropous. The seed coat is made up of two integuments. The ovule is made up largely of parenchymatous tissue which in the early stages contains a great deal of starch. Upon the thickening of the endosperm cells this starch disappears.

A cross section of a recently fertilized ovule of *Malope trifida* Cav. discloses that but a slight differentiation in the two integuments has taken place; they are made up of prismatic cells, which in the outer layer are rectangular, while in the inner they are more nearly isodiametric. The difference is not alone in form; the outer integument is distinctly clearer than the inner, which is rich in protoplasm. This indicates that we are to have a more marked change in the inner than in the outer integument. In the course of development the cells of the outer integument change but slightly, simply increasing in size. The small starch grains contained in it disappear with the thickening of the walls of the cell. From the great radial growth of the first layer of cells in the inner integument and the thickening of the outer layer in the outer integument, the second layer of the outer integument is compressed until the upper and lower cell-walls are nearly or quite contiguous.

More decided changes take place in the inner integument. The second cell layer takes on a rounded form while the third layer of cells has been divided parallel to the endosperm. The second layer of cells increases rapidly in size compressing the fourth layer. During this time the first layer has lengthened out radially until the length of a cell is nearly three times its width. This layer is known as the palisade layer, which is so characteristic in this order. The palisade cells contain starch in the early stages. During the thickening of the walls the amount of starch diminishes. When the cell-walls have reached their thickness the starch has disappeared.

In a mature palisade cell, a cell cavity may be seen about one-third the distance from the outer end. These cavities often contain a spherical mass resembling a nucleus, which dissolves readily on the application of Schulze's medium. Between the cell cavity and the outer end of the palisade cell appears the light line which is present in a number of orders.

It appears as a continuous pellucid band (fig. 1 *l.*) across the outer end of the palisade cells. In the Leguminosæ this was noticed, at least as early as 1838, by Schleiden and Vogel.[11] The nature of this light line has been studied by a number of investigators. Quite different views have been taken in regard to it.[12]

Russow,[13] after investigation, comes to the conclusion that the cell-wall is more compact and contains less water at this place. Sempolowski[14] is of the opinion that it may be due to a differentiation in the molecular structure of the cell-walls. Lohde,[15] who studied carefully the development and structure of the seed coats of some Convolvulaceæ and Malvaceæ thinks that it arises from the cuticularization of small particles of the palisade cells. Junowicz,[16] after an exhaustive study, finds that the light line is present only in palisade cells; that the cell-wall at this place refracts light strongly, and that the refraction not due to a chemical change in the cell-wall, i. e., cuticularization. Beck[17] says that it cannot be due to a cuticularization, nor is there a difference in the amount of water contained in that part of the cell-wall, although there are certain chemical and physical differences.

Immediately under the palisade cells are two layers of roundish cells of dark brown color. The number of integuments in the different species studied is the same, and the number of layers of cells in each integument is practically the same.

ALTHÆA ROSEA Cav.; fig. I.—In specimens of A. rosea the outer integument, *a b*, has both layers of cells developed, the outer layer, *a*, being developed rectangularly in a tangential direction. This layer gives rise to the epidermal outgrowths, or seed hair. The next layer, *b*, is nearly isodiametric.

[11] VOGEL: l. c. Vol. XIX. pars II, taf. XLIII, fig. 55, 58; taf. XLV, fig. 77, 80. Nova Acta der Leop. Car. Academie.

[12] O. MATTIROLLA: La linea lucida nelle cellule Malphigiani degli integumenti seminali. Mem. della R. Acc. delle Sc. di Torino. Ser. II, Vol. XXXVII. See abst. Just's Bot. Jahresb., 1885. p. 825.

[13] RUSSOW: Vergleichende Untersuchungen über die Leitbundel-Kryptogamen, pp. 32. St. Petersburg, 1872.

[14] SEMPOLOWSKI: Beitræge zur Kenntniss des Baues der Samenschalen, p. 11, Leipzig, 1874.

[15] LOHDE: l. c., p. 30, 36.

[16] JUNOWICZ: Die Lichtlinie in den Prismenzellen der Samenschalen, p. 3, p. 18; p. 17. Prag, July 12, 1877.

[17] GUNTHER BECK: Vergleichende Anatomie der Samen von Vicia und Ervum, pp. 32. Sitzb. d. k. Akad. d. Wissensch. Band LXXVII. I. Abth. Mai Heft. 1878.

There is no deposition of intercellular matter in this integument nor between the two integuments. The palisade cell, *c*, is of moderate size. The cell cavity is nearer the upper end than ordinary. Nodosity is not often present. The light line, *l*, is not so sharp or distinct as in many species. The sub-palisade portion, *d*, is made up of a layer of large cells and several small ones. The small cells are narrow. The whole is of a chestnut brown color. The endospermal covering, *e*, is rather delicate. The first layer of cells in the endosperm, *f*, is made up of regular cells.

Measurements: seedcoats, 104μ; outer integuments, 29μ; outer layer of same, 11μ; inner layer of same, 18μ; palisade layer, 52μ; sub-palisade, 23μ.

MALVA SYLVESTRIS L.; fig. II.—The surface of M. sylvestris is rough in appearance. The second layer, *b*, of the outer integument, *a*, has been compressed into a thin layer and seems to have no definite arrangement. The outer layer, *a*, has been elongated radially. In places these elongated cells have divided forming a double layer of cells. There is no brown coloring matter in this integument nor is there any between the integuments. The palisade cells, *c*, are clear; the walls thick. The cell-cavity occupies about one-third the length of the cells, the lower end reaching to the middle. The nodosity is prominent. Below the cavity the cells are clear, almost transparent. The sub-palisade portion, *d*, is usually made up of two layers, at some places only one, of large dark brown cells.

Measurements: seed coats, 122μ; outer integument, 27μ; outer layer of same, 22μ; inner layer of same, 5μ; palisade layer, 70μ; sub-palisade, 25μ.

CALLIRRHOE TRIANGULATA Gray; fig. III.—The inner layer, *b*, of the outer integument is developed into isodiametric cells. The outer layer, *a*, is drawn out tangentially until linear. The cells are colorless and are closely contiguous to the palisade layer. The palisade layer, *c*, is clear throughout, with the borders of the cells sharply defined. Cell-cavity is large and near the upper end of the cells; nodosities prominent. The light line, *l*, is wide and sharply defined. The sub-palisade portion, *d*, is composed of two layers of cells, the cells of the upper layer having very thick brownish walls.

Measurements: thickness of seed coats, 90μ; outer integument, 9μ; inner layer of same, 6μ; outer layer of same, 3μ; palisade layer, 63μ; sub-palisade layer, 18μ; length of sub-palisade layer, 28μ.

CALLIRRHOE INVOLUCRATA Gray; fig. IV.—The outer layer, *a*, of the first integument is developed into large cells. This is just the reverse of C. triangulata. The cells are variable; some are isodiametric; they elongate gradually until some are almost linear tangentially. This layer is colorless. The inner portion of the palisade-cells, *c*, is almost transparent. The cell-cavity is very large and situated nearer the middle of the cell than in most cases. The light line is not sharp and quite near the outer end of the cell. The sub-palisade portion, *d*, is composed of two layers of large cells, the larger being nearer the palisade cells.

Measurements: seed coats, 62μ; outer integument, 8μ; outer layer of same, 6μ; inner layer of same, 2μ; palisade layer, 39μ; sub-palisade, 15μ.

MALVASTRUM ANGUSTUM Gray; fig. V.—The second layer, *b*, of the outer integument is developed into radially elongated cells. These cells are about twice as long as wide. The outer layer contains no coloring matter. The cell-walls between the first and second integument contain a small amount of yellowish coloring matter. On each side of the outer integument is a narrow band, *i*, that refracts light strongly. The palisade cells, *c*, are quite remarkable in having the clearest portion occurring outside of the cavity. This may account for the apparent dimness of the light line, *l*. The position of the light line is normal. The cell cavity is large and the nodosity prominent. The sub-palisade portion, *d*, contains one layer of very large dark brown cells. The large cells take a diagonal position. In some specimens they look like an S. This is not quite so striking in *M. coccineum* Gray.

Measurements: seed coats, 104μ; outer integument, 9μ; second layer of same, 8μ; palisade layer, 65μ; sub-palisade, 30μ.

SIDA NAPÆA Cav.; fig. VI.—The outer integument, *a*, *b*, is composed of two layers of cells about equally developed. The shape in both layers is quite variable, from elongated radially to elongated tangentially. The cell-walls are colored yellowish brown.

The outer portion of the palisade cells, *c*, especially around the cell cavity, is more or less yellowish. The light line, *l*,

is not very prominent and quite near the end of the cells. The lower portion of the cells is colorless, almost transparent. The sub-palisade portion, *d*, is composed of two layers of cells. These cells are large, brown and elongated tangentially.

Measurements: seed coats, 120μ; outer integument, 24μ; palisade layer, 70μ; sub-palisade layer, 26μ.

ABUTILON AVICENNAE Gaertn.; fig. VII.—The outer layer, *a*, of the first integument is transformed into a strongly refractive layer. Thes econd layer is composed of radially elongated cells. The seed hairs arise from a single cell and are large and conspicuous. The hairs are spindle-shaped and thin walled; they occur mostly at the ends of the seed and are more or less pressed to it. There is little or no coloring matter in this integument excepting in the base of the hair cells. The palisade cells, *c*, are narrow for their length. The cell cavity is not prominent and the nodosity is inconspicuous. The light line is narrow and occurs near the outer end of the palisade layer. The sub-palisade portion, *d*, is made up of two layers of light brown cells. They are symmetrical and elongated tangentially.

Measurements: seed coats, 147μ; outer integument, 13μ; palisade layer, 96μ; sub-palisade, 38μ.

MODIOLA MULTIFIDA Moench.; fig. VIII.—The first layer, *a*, of the first integument is developed into tangentially elongated cells. The second layer; *b*, has been compressed into an irregular shape. This layer contains much yellowish coloring matter. The palisade layer, *c*, is clear, almost transparent, the cell cavity long and the nodosity not conspicuous. Both the cell cavity and the nodosity lack the yellow color usually present. The light line, *l*, is indistinct. The sub-palisade portion, *d*, seems to be made up of two layers of cells. The cells of the different layers alternate. The outer layer is composed of very large spherical cells. The second layer is also made up of spherical cells but not so large as the outer; both are of dark chestnut brown color. Below this is a thick portion of irregularly shaped cells of brown color.

Measurements: seed coats, 84μ; outer integument, 14μ; palisade layer, 32μ; width of same, 4μ; sub-palisade, 38μ; diameter of upper layer, 26μ; diameter of lower layer, 14μ.

HIBISCUS MILITARIS Cav.; figs. IX, X, XI.—The first layer, *a*, of the outer integument is most prominently developed. This layer gives rise to the seed hairs. These hairs, *h*, are spindle-shaped, with the walls thin and fragile. The walls of the basal cell are stronger than the neighboring cells. The seed hairs are made up of single cells each containing a small amount of granular matter at the base. The color of the integument is chestnut brown. Cells in the second layer, *b*, are elongated tangentially. The palisade layer, *c*, is composed of large cells, wide in comparison with their length. The cell-cavity is comparatively small, the nodosity prominent. The light line, *l*, is strong and large. Under ordinary magnification ($\frac{1}{6}$ objective) it appears as an unbroken band across the outer end of the cells. Using a strong magnification ($\frac{1}{10}$ or $\frac{1}{16}$ oil immersion) each cell-wall interrupts the line. The portion of the light line in each cell is divided or nearly divided into two or three bodies. Under an analyzer the light line takes on blue a little earlier than the adjoining field. When the field is most intense blue the light line is dark on the inner border and dark blue on the outer. Just before the section comes into focus the light line appears dark taking on the characteristic colors when in focus, while the color of the adjoining field does not depend upon the focus. A thick section shows the following colors under the analyzer, blue, green, yellow, pink. The colors appear only above the cell-cavity. The portion below the cell-cavity gives only blue and yellow distinctly. The cell-cavity agrees with the upper portion of the cells. The nodosity does not change polarized light. The other cells of the seed-coat give no decided reaction under the analyzer. After isolation a cell parts easily immediately below the cavity and sections often behave in a similar manner. The cells, fig. X, are usually pentagonal and somewhat elongated in the direction of least circumference. (Fig. XI.)

The sub-palisade portion, *d*, is composed of three prominent layers and a number of less regular closely massed cells. This layer has a great amount of dark coloring matter, which is a dark chestnut brown.

Measurements: seed coats, 187μ; outer integument, 26μ; outer layer of same, 17μ; inner layer of same, 8μ; palisade layer, 103μ; sub-palisade layer, 58μ.

Lake City, Fla.

Evolution in methods of pollination.

ALICE CARTER.

In attempting to arrange our phanerogams in a natural order, I have been astonished at the close resemblance even in external appearance between the reproductive organs of Coniferæ and Pteridophyta; at the Equisetum-like arrangement of the spore cases (anthers and ovules) in many of our exogenous trees, such as Alnus and Betula, whose inflorescences are not highly specialized; and at the return to the moss-like or frond-like form of degenerate water plants, e. g., Lemna, Wolffia and Myriophyllum. The essential similarity in the life processes of all the higher plants, pteridophytes and phanerogams, is a fact familiar since the days of Hofmeister, and is constantly receiving confirmation. For instance, Stengel has recently described the beautiful transition in anatomical structure and origin between the macrosporangia (ovules) of gymnosperms and angiosperms. The discovery of such analogies is one of the great achievements of modern botany, making it possible, by embryology and histology, to trace the ascent from mosses to exogens, picturing to us the development which geology shows has been going on in time.

Variation is the source and presupposition of this development. Change of conditions and cross-fertilization are the two great known causes of variation. The first, in the case of fixed plants works slowly; the second includes within itself the advantages of the first and others of its own; for by it the characteristics of dissimilar parents, whose differences are to a certain extent the results of the dissimilarity of the conditions to which they have been subject, are transmitted in varying proportions to succeeding generations. New properties are thus acquired and old ones changed, and the variable descendants of crossed plants conquer the unimproved offspring of self-fertilization.

The process of conjugation in the lowest plants in which there is a sexual reproduction, in almost all cases makes probable the union of the spores of two distinct individuals (Spirogyra, Mucor, Desmidiaceæ, Diatomaceæ, etc.), while the same possibility of cross-fertilization is insured among the higher thallophytes, liverworts and pteridophytes by motile antherozoids, which are so small that the moisture of the damp places in which

the prothallium or sexual generation always grows is sufficient to carry them, sometimes at least, to the germ cells of distinct plants. The wind, too, helps as the means of scattering the asexual spores from which the sexual generation grows.

Among phanerogams the power of elongation of the antherozoid-bearing pollen tube takes the place of the movement of the antherozoid itself, but still the asexual spores of pines, grasses, sedges, and of many forest trees are carried by the wind to the oospheres which they fertilize. Most of these anemophilous plants are probably old types; the Coniferæ, for example, which are all anemophilous, are acknowledged to have been the precursors of the higher monocotyledonous vegetation. They are all anemophilous. Geologists tell us that monocotyledons appeared before exogens; their structure is simpler and they are in many respects a connecting link between these and gymnosperms. Five of the 22 orders of endogens described in Gray's Manual (revised edition) are anemophilous, a large proportion; one is partly wind-, partly water-fertilized; several others are largely hydrophilous, also a primitive method common among degraded water plants such as Vallisneria and many Naiadaceæ.

The very fact that whole orders of endogens have this characteristic of wind-fertilization proves it to be an ancient one, for the features which are common to all members of an order are necessarily as old as the order itself, and the possession of the same property by several orders of a class indicates still greater age. The wide distribution of some of their genera (there is none wider among phanerogams) and the comparative lack in variety of the Cyperaceæ, Gramineæ, Juncaceæ, Eriocauleæ and Typhaceæ point to the one conclusion, that these wind-fertilized endogens are among the oldest of flowering plants.

For somewhat similar reasons many of the anemophilous dicotyls may be considered old types. They are almost all apetalous—a sign of low development; a sign, too, of old age, for the apetalous was the dominant type of dicotyls in the mid-Cretaceous, forming forty-five per cent of them as against fourteen per cent now. This decrease in numbers is suggestive of extinction and another mark of old age. Further, of the twenty-three apetalous orders represented in our flora, six are anemophilous. These are the Salicaceæ, Cupuliferæ, Myricaceæ, Juglandaceæ, Platanaceæ and Piperaceæ. (Excep-

tion must be made of the genus Salix which has developed means of insect attraction). Of these the Salicaceæ are known to be old, for the oldest fossil dicotyledons are of the genera Salix and Populus. None of them include many genera, and this again is a common attribute of old orders and a sign of approaching extinction, according to Darwin's rule that the dominant orders are those of numerous genera and species.

Piperaceæ	include	8	genera	and	1000	species.
Platanaceæ	"	1	"	"	6	"
Juglandaceæ	"	5	"	"	30	"
Myricaceæ	"	1	"	"	35	"
Cupuliferæ	"	10	"	"	400	"
Salicaceæ	"	2	"	"	200	"

The genera are conspicuously few. The Piperaceæ alone have a large number of species and of their method of fertilization I am not sure. The group Saurureæ, represented in our flora, is apparently adapted to wind-fertilization. Moreover many members of the Chenopodiaceæ, Amarantaceæ, Polygonaceæ, Urticaceæ and some Empetraceæ are anemophilous. All this is in marked contrast to the state of things among the younger and more highly developed exogens. For of the 50 polypetalous orders one is partly wind, partly water-fertilized; of the 33 gamopetalous orders, only one is largely anemophilous, and of that one, the Plantagineæ, the typical genus is considered by some authorities to be degraded.

Here, too, the question of color comes to our aid. In every one of these ten apetalous orders the predominance of greenish inflorescences is very noteworthy as a further sign of low organization and of relationship with glumaceous endogens, pines, and pteridophytes. F. F. Mott[1] says that dull color means the absorption of vibrations of every wave length; deep red, deep violet or green that about two-thirds of the wave lengths are absorbed, about one-third reflected; scarlet, yellow, blue or purple that about one-third of the wave lengths are absorbed, about two-thirds reflected. He adds that these three stages of color show therefore three stages of progress in the direction from generalization to specialization, a progress such as marks all development. Accordingly we should expect to find, as we do, greenish and dull shades prevalent among the least highly organized, and

[1] American Naturalist, Sept. 4, 1890.

therefore, other things being equal, the oldest inflorescences. On the other hand, among the dominant forms of to-day, the greatly specialized Compositæ, Umbelliferæ, Leguminosæ, Orchidaceæ, Labiatæ, Scrophulariaceæ, Rubiaceæ, Ericaceæ, etc., bright reds, blues and orange yellows are common. There are 23 orders of the world flora which contain 1000 species or more. Inconspicuous flower clusters are characteristic of only five of these, viz: the Cyperaceæ, Gramineæ, Urticaceæ, Piperaceæ and Euphorbiaceæ. The first and second are very old types, the third and fourth apetalous (probably old), the last degenerate.[1] It seems then logical to call these inconspicuous, little protected clusters of stamens and pistils ancient forms of flowers and to consider wind-fertilization, which is so common among them, a primitive method.

But the crossing of individuals must be a most desirable thing if it is to be obtained at such enormous cost, for pollen is precious material, yet for every grain which the wind carries to an ovule thousands are swept to destruction. Self-fertilization would apparently be a much surer and cheaper process. The end, however, justifies the means, otherwise crossed plants would long ago have yielded place to self-fertilized victors. Darwin, by a most careful and elaborate series of investigations of more than a thousand plants, has shown that "wherever plants which are the offspring of self-fertilization are opposed in the struggle for existence to the offspring of cross-fertilization, the latter have the advantage. In no single case was the advantage on the other side."[2] So wind-fertilized plants waxed strong and multiplied on the face of the earth.

Meanwhile "away back in the darkness of the coal period, when tree-ferns, calamites and giant club-mosses combined with archetypal yews to people the steaming swamps of a hot, cloud-laden island world, there existed a strange form of insect which can only be compared to the cockroaches of our day, but which seems to have embodied in its structure the beginnings of all the varied types of insect life, the promise and

[1] White and yellow are the predominant colors of our own flora; 420 yellow, 614 white species among the 2056 flowers of Gray's Manual (revised edition). It would be interesting to know whether there is a larger proportion of reds and blues in the tropical lands where flower-frequenting birds and butterflies are more abundant. Wallace's statement of the surprising monotony of tropical vegetation is not necessarily opposed to this.

[2] H. Müller.

prophecy not only of our dragon-flies, and beetles, but also of our flies, bees and butterflies."[3] Scudder sums up what was known of American fossil insects about nine years ago in this way: "The species of fossil insects known from North America number eighty-one; six of these belong to the Devonian, nine to the Carboniferous, one to the Triassic and sixty-five to the Tertiary epochs; the Hymenoptera, Homeoptera and Diptera occur only in the Tertiaries; the same is true of the Lepidoptera, if we exclude the Morris specimen, and of the Coleoptera with the Triassic exception. The Orthoptera and Myriopoda are restricted to the Carboniferous, while the Neuroptera occur both in the Devonian and Carboniferous formations." Packard says: "the lower forms of Hymenoptera, so far as the scanty records show, appeared first in the Jura formation."

From these statements its seems probable that the period of the appearance of dicotyledons was also the time of the development of our great groups of insects. The two have been hand in glove ever since. Insects wandered to and fro seeking what they might devour, and if the man is blessed who makes two blades of grass grow where only one was, thrice happy is the insect which discovers an entirely new source of nourishment by which its food supply is many times multiplied. Accidentally lighting on a staminate flower cluster, as I have seen bees and flies do on the wind-fertilized inflorescences of Poterium Canadense, it finds itself in the land of plenty and thereafter is on the outlook for food-magazines of the same kind. The flowers with highly colored bracts (represented in the flora of to-day by some species of Euphorbia and Amarantus), or those with colored stamens, (such as species of Thalictrum, Corema and Plantago now show as the first step toward insect attraction), being more conspicuous will be more frequently visited. Visitors leaving the flowers carry with them pollen which clings to the hairs of their bodies, and some of this will occasionally be left on the feathery stigmas of the pistillate clusters which will also be visited, at first in vain. The ovules so fertilized ripen seeds which inherit the peculiarities of their parents to a greater or less degree.

This is then, as far as we know it, the story of the origin of flowers, which were at first merely axes bearing spirally ar-

[3] Lester F. Ward.

ranged reproductive organs, such as the antheridial and archegonial clusters of mosses or the spore-bearing stalks of ferns and equisetums. The growth of bracts, i. e., leaves altered to do protective work, and the further development in the macrosporangium mouth of the mucilaginous secretion already foreshadowed in the archegonia of ferns, produced the characteristic inflorescences of gymnosperms. The position of a plant, as of a man, in the scale of progress, is measurable by the protection given to the children and by the manner of their preparation for independent life. The increase of ovule-shelter by the formation of a closed ovary is an easy step, as the comparison of the ripened pods of Mitella, Tiarella, Aquilegia or almost any of the Leguminosæ with the ovule-bearing scales of pines, shows. By the incurving of the edges of one of these scales, or more probably, by the persistence of the inrolling of the edges of the young leaf, an ovary perfect in every essential would be produced, and the favorable variation transmitted to succeeding gererations.[1] Still further provision for the safety of the seeds and for their advancement in life, is attained by increased development of the protective bracts to form organs such as the perigynia of sedges, the glumes and awns of grasses, the hairs of Eriophorum, etc.; more complete adaptation to wind-fertilization by the formation of microsporangium stalks (filaments, sometimes feebly developed in the Coniferæ) and of feathery outgrowths (stigma) from the united tips of the carpellary leaves.

Then the lords of horticulture, the insects, with an eye to profit, began their investigations of the fields, at first obtaining only pollen from these wind-tossed inflorescences. In some cases they never find anything more, e. g., in Hepatica and Papaver. But the occurrence of sugary secretions,

[1] Some time after writing this sentence, I came across a remarkable confirmation of the truth of the theory in Eichler's "Blüthendiagramme," part II, p. 216. He says: "In most Resedaceae the carpels are so united that they form a one-celled ovary with parietal placentae, . . . yet they remain free from one another at the top, nor do the edges of the individual carpels close together there, so that the ovary is open above. . . . The condition of things is somewhat different in Reseda luteola, Caylusea and Astrocarpus. In the first species the individual carpels remain separate, their edges turned inwards and meeting below to bear the ovules in the ordinary way, but not touching above so that each carpel is open far down on its inner suture. In Caylusea there is neither union of the carpels, nor closing together of the edges of each one separately; the ovary *appears therefore to be made of five or six free scales which stand in a circle* — a very primitive structure, not occurring elsewhere in this form." The state of things in Tiarella cordifolia seems to me to correspond well to this description of the pistils of Reseda luteola.

common elsewhere, as on the petioles of the passion vine and on the leaves of the larch where bees busily search for them, among the floral organs is a not surprising result of the energy of the currents which nourish anthers and ovules.[1] Such secretions at first perhaps not abundant, nor perceptibly sweet, will be gradually increased and improved by means of this co-working of plant and insect. Stages in the evolution of nectar and of nectar-protecting organs are represented to-day, steps which connect the watery fluid found exposed the first day of blossoming in the stigmatic cavity of Nymphæa tuberosa, the drops of liquid at the bases of the carpels of Caltha, the honey protected by scales on the petal bases of Ranunculus and by elongated petal-bases (i. e. spurs) of Aquilegia, etc., with the showy buckets of Marcgravia from which the brilliant sun birds of India drink nectar worthy of the gods.

The result of this long-standing partnership is, that, in the place of a world of green, corolla-less flowers, our meadows are rich with the gold of daisies and buttercups; our hillsides, covered with the blue of innocence; our rocks, purple with clematis, or gay with columbine; asters and golden-rods reflect royal colors in the brooks; gentians give back the blue of the sky from the mountain pastures; and there are glorious fringed orchids for those who can find them, and they are the bees and butterflies. For the good poet was mistaken in supposing that many a flower is born to blush unseen. The bees who have made it blush will surely be there to see.

Ithaca, N. Y. [*Concluded next month.*]

Mt. Kataadn and its flora.

F. LAMSON-SCRIBNER.

In August, 1874, a party of gentlemen from Bangor and Orono, under the direction of President M. C. Fernald of the Maine State College, made the ascent of Mt. Kataadn for the purpose of determining more accurately than had before been done, the altitude of the mountain. This work was accomplished by Prof. Fernald in a very thorough and accurate manner, and his observations were made public at that time.

Mr. F. W. Hardy, a well known photographer of Bangor,

[1] cf. BONNIER: Comptes Rendus, LXXXVIII. 662.

accompanied the party and succeeded in obtaining some excellent stereoscopic and other views of the mountain and its surroundings.

From Bangor we proceeded by rail to Mattawamkeag, thence thirty-five miles by stage to Sherman. From the latter place we were carried with our baggage, by private conveyance through Stacyville to "Hunt's Farm", on the banks of the East Branch, a distance of ten miles. An excellent guide was procured at Stacyville, in the person of Mr. J. C. Stacy, a gentleman who very faithfully served us on a similar excursion the year before.

Hunt's Farm was then owned by a Mr. Patterson, a stalwart and obliging man who had about him a large family of bright and healthy boys and girls. Mr. Patterson's nearest neighbors were distant about six miles, and his hospitable dwelling, which served as a hotel for the lumbermen in the winter season, was the last one on our route to the mountain. We crossed the river in a bateau and the remaining twenty miles of our journey were through a continuous forest, which we traversed on foot. There was a good logging road to within two or three miles of the mountain, so that our walk was not a severe one. Indeed a person might ride on a sure-footed horse the greater part of the distance. Within the first six miles we twice forded the Wissatiquoik River, which empties into the East Branch near "Hunt's Farm". The fords were easily and quickly accomplished, but at the second crossing our task became more laborious for we were then obliged to assume the burden of our provisions and blankets which thus far had been transported by horses.

Five miles farther on, at the foot of Kataadn Lake, we had our first good view of the mountain, sharply and boldly defined against the western sky. The sight inspired us with new courage and enthusiasm, and after a brief rest we hastened on, and near the close of the third day from Bangor we arrived at the foot of grand old Kataadn, with its naked summit majestically towering directly above us. After a good night's rest and an early breakfast we prepared for the real labor of our excursion, that of the ascent, but with it came the real enjoyment which we so long held in anticipation.

Without a load one may ascend the mountain from the foot of the eastern spur, or "ridge" as it is termed, and return in a day. But a person unused to such scenery will form but a

vague idea of the mountain if he makes but one ascent. He must ascend and reascend; he must dwell upon its lofty peaks and view in varying lights its grand proportions; he must descend its vast slides filled with decomposed granite and immense boulders that appear as though the slightest push would send them rolling down the mountain side; he must descend the "long crooked slide" where by a slip he might be dashed upon the sharp rocks hundreds of feet below or where an incautious step might set in motion an avalanche of huge boulders; he must pass down into the "notch" and over the "chimney"—a feat seemingly impossible to the inexperienced. The "narrows" must be traversed, where there is barely a footing and from whence a jump of more than two thousand feet may be made upon the one hand or a tumble hardly less great upon the other. The "northern tablelands" must be visited, and the mountain "basin", where exists a small lake of the purest water. This basin is enclosed upon three sides by perpendicular walls of solid rock, nearly two thousand feet high. All this must be done and more, ere one can obtain any correct impression of the grandeur and immensity of this mountain.

Situated in the eastern part of Piscataquis County, and in the very heart of the lake and mountain scenery of Maine, Mt. Kataadn stands without a rival in New England in the wild grandeur of its proportions: and in its alp-like character it has no equal in the Eastern States. The altitude, as determined by the observations of Prof. Fernald, is five thousand two hundred and fifteen feet, making this mountain the highest point of land in the state and but a little lower than Mt. Washington in New Hampshire. The views to be obtained from its summit can hardly be surpassed either in beauty or extent. The peculiar features of the flora of this locality cannot fail to be of interest to the student of botany, and it is our purpose to present in this paper some botanical notes made during our stay upon the mountain.

Upon a previous visit (in 1873) we made the ascent by the way of the "eastern slide", which is, perhaps, the easiest if not the best place for the purpose. Around the base of this slide a small form of the white birch is the prevailing tree; probably *Betula papyracea*, var. *minor* Tuck. Ascending the slide, this tree rapidly dimishes in size, till finally it becomes a mere dwarf and disappears entirely before reaching the first

"horseback". The lower portion of the mountain is covered with a dense growth of dwarf black spruce, so dense as to be wholly impassable, except by tumbling or rolling over the summits of the closely growing trees.

At the foot of this slide along the borders of a cold mountain stream, grows the bright-flowered *Arnica mollis* Hook. Dr. Goodale in the Report of the Maine Board of Agriculture for 1862, in speaking of this plant, says: "It is found sparingly near Moxie Falls, a few miles from the forks of the Kennebec. It occurs in great beauty and profusion in the vicinity of the cataract of Parlin Pond stream, where its orange flowers are sprinkled with the spray of the falling water. The iridescence of the flowers as they were bathed in the sunlight and spray was a spectacle of much beauty, the orange blossoms here and there, overpowering the rainbow coloring of the drops of water."

Nearly half way up the slide, an ice-cold spring issues from the side of the mountain, and its waters, rushing down over the steep rocks, form the brook just alluded to. Along this stream the green mountain alder, *Alnus viridis*, grows in luxuriance. Above the spring this shrub gives way to more alpine forms: we soon meet the dwarf birch (*B. glandulosa* Mx.), a rather pretty little shrub abundant on the high mountains of New England and New York, and growing as far north as Hudson's Bay. Fruited specimens less than three inches high were gathered on the "horseback". With the birch and extending above it, we find the little mountain cranberry, *Vaccinium Vitis-Idæa*. This is a low spreading shrub with numerous short, upright branches. The berries are numerous, of a dark red color, with an acid taste. They are gathered and made into sauce, like the common bog cranberry. The sweet berries of the bog bilberry, *V. uliginosum* L., and mountain blueberry, *V. cæspitosum*, refreshed us on our tedious ascent. At the summit of the slide, occurring quite frequently and rising but an inch or two above the rocks on which it grew was Cutler's willow, *Salix Cutleri* Tuck. It may be recognized by its strongly veined, elliptical leaves. With this species occurs also *S. herbacea* L., a species of even smaller habit than the last.

Forming dense, convex mats over the surface of the rocks is the curious *Diapensia Lapponica* L., a small evergreen plant of the Phlox family. The remains of the white flowers, which

appear in July, were still present. As we neared the summit of the slide, the crowberry, *Empetrum nigrum* L., made its appearance. This is a small, prostrate, much branched shrub, with very numerous, narrow leaves, giving the plant a heath-like aspect. The flowers open in early summer. In August, the plants were loaded with small black berries. Ascending the "Horseback" towards the "Chimney", we passed large patches of the beautiful little mountain sandwort, *Arenaria Grœnlandica*. The flowers of this species are quite large when compared with the plant and are of a delicate white tint.

Upon our present trip we started from Reed's camp and proceeded through dense groves of tall spruce trees, which became smaller and yet more dense as we advanced towards the eastern spur, up which we were to climb, and such a climb! With our packs upon our backs, and no path, not even a spotted line to direct our course! We come upon huge boulders over which we must climb, or around which we must force our way through an almost impenetrable forest of dwarf birch and stunted fir. By dint of perseverance and severe exertion, we labor upward; now walking almost upon the very tops of the low but wide expanded evergreens, now losing our footing and slipping helplessly into dark caverns between high and mossy rocks. Two hours, or perhaps more, of this travel and we are above the growth of trees and have passed through that dense growth of vegetation called by the woodsmen "pucker-brush". We are now more than three thousand feet above the sea level. Our birch tree exists only as a low shrub and soon gives way to another species, the little *Betula glandulosa*, which rises but a few inches above the rocks upon which it grows, or rather to which it clings. About us there is still to be seen an occasional spruce, but so reduced in size that we can hardly recognize in it any relationship to the majestic forms that clothe the hills now far below us. For how many centuries the stunted forms before us have braved the severe mountain storms and fierce winters we know not, but that their whole existence has been one constant warfare with the untamed elements their meager and ancient appearance will testify — the vertical trunks rising but a few inches above the stony soil, the densely grown and thickly clothed branches carpeting the rocks like some sharp leaved moss. A few steps upward and we are in the midst of plant forms that belong to the frigid zone. Here in profusion we find the small moun-

tain blueberry, *Vaccinium cæspitosum*, the mountain cranberry, *V. Vitis-Idæa*, and the heathlike crowberry, *Empetrum nigrum*, plants that abound in Greenland and furnish berries that form the only vegetable diet of the dwellers in that arctic country.

The only species peculiar to Mt. Kataadn is *Saxifraga stellaris*, var. *comosa*. The other forms, so far as noted, are identical with those upon the White Mountains and other high altitudes in the United States. The upper limit of erect shrubs is between three and four thousand feet.

Below is a list of those plants observed upon the mountain or in its vicinity.

1. *Clematis verticillaris* DC. Abundant along the banks of the East Branch, in fruit. This vine grows in profusion at Orono, Maine, where it blooms about the 25th of May.

2. *Cardamine bellidifolia* L. In the "Long Crooked Slide" which runs down from near the highest peak of the mountain.

3. *Arenaria Grœnlandica* Spreng. Common on the rocks of the Eastern Ridge, or "Saddleback". Although perfectly at home upon the bleak mountain tops of New England, it is sometimes found in Maine upon the rocky river banks near the sea.

4. *Saxifraga stellaris* L. var. *comosa* Willd. Found only under the shade of rocks on the ridge north of the summit of the mountain. The flowers of all the specimens I saw were changed into little tufts of green leaves.

5. *Epilobium alpinum* L. Only one or two specimens seen in the "Basin" of the mountain.

6. *Linnæa borealis* Gronov. Common in damp woods throughout the State, blossoming about the middle of June. I found it growing in damp moss on several of the lower points of the mountain in bloom at the time of my visit (Aug. 15).

7. *Nardosmia palmata* Hook. Noticed in swamps near the mountain. It grows in great abundance at Orono, Maine.

8. *Aster graminifolius* Pursh. On dry rocks of the East Branch.

9. *Solidago Virga-aurea* L. var. *alpina* Bigel. In several places on the mountain. This is a bright little species of golden-rod and often expands its heads of golden yellow flowers barely an inch above the rocks on which it grows.

10. *Solidago thyrsoidea* E. Meyer. Common, especially

in the "Long Crooked Slide", and near the northern "Table Lands".

11. *Gnaphalium supinum* Villars. On rocks in the "Basin". The specimens were out of bloom.

12. *Arnica mollis* Hook. Near the foot of the Eastern Slide and also along the borders of a lake near the "Eastern Spur" of the mountain, where it is very abundant.

13. *Cirsium muticum* Mx. Common near the mountain.

14. *Nabalus nanus* DC. Common on the higher portions of the mountain, especially near the northern "Table Lands".

15. *Nabalus Boottii* DC. With N. nanus, but not so abundant.

16. *Lobelia Kalmii* L. Abundant on rocks along the East Branch. I have also found this plant on the banks of the Kennebec at Waterville.

17. *Campanula rotundifolia* L. A diminutive mountain form grew in the "Notch" near the "Chimney". The plants were only four inches high, simple, terminated by a single flower.

18. *Vaccinium Vitis-Idæa* L. Common especially on the "Saddleback". Upon the shady and moss-covered rock-shelves on the north side of the "Chimney", specimens were gathered in flower. This is the mountain cranberry of the north. The slightly acid, refreshing berries are collected in quantities for making sauce and preserves.

19. *Vaccinium uliginosum* L. Common.

20. *Vaccinium cæspitosum* Mx. Is a very small species producing sweet, blue berries,—also common.

21. *Vaccinium Pennsylvanicum* Lam. The alpine variety of this species (var. *angustifolium*) grows on the north "Table Lands."

22. *Chiogenes hispidula* T. & G. Common on the lower portion of the mountain, also in swamps throughout the state.

23. *Arctostaphylos alpina* Spreng. Quite common on the higher altitudes. In fruit.

24. *Cassiope hypnoides* Don. This charming little heath-like plant I found only on the eastern edges of the north "Table Lands". The plants were in fruit.

25. *Kalmia glauca* and *K. angustifolia*. Found on the "Saddleback". The former in flower.

26. *Phyllodoce taxifolia* Salisb. Common along the "Narrows".

28. *Rhododendron Lapponicum* Wahl. North "Table Lands".

29. *Loiseleuria procumbens* Desv. On rocks north of the summit, common.

30. *Moneses uniflora.* In flower on the northern portions of the mountain and throughout the state in cool swamps, blooming about the last of June.

31. *Diapensia Lapponica* L. Abundant on the "Saddleback". In fruit.

32. *Polygonum viviparum* L. Found only in the "Long Crooked Slide," in flower and fruit.

33. *Empetrum nigrum* L. Very abundant in the eastern portion of the mountain.

34. *Betula papyracea* Ait. var. *minor* Tuck. Common on the lower portions of the mountain.

35. *Betula glandulosa* Mx. Common on the mountain. Well fruited specimens less than three inches high were collected.

36. *Alnus viridis* DC. Common on lower slopes along streams.

37. *Salix argyrocarpa* Anders. Common.

38. *Salix herbacea* L. On the "Saddleback", in moss.

39. *Scheuchzeria palustris* L. In a bog near the mountain.

40. *Listera cordata* R. Br. In flower in the sag between the summit and the north "Table Lands."

41. *Orchis dilatata* Gray. Common in the swamps near the mountain.

42. *Luzula parviflora* Desv., var. *melanocarpa.* Abundant.

43. *Luzula spicata* Desv. Common.

44. *Juncus filiformis* L.

45. *Juncus trifidus* L. Common.

46. *Scirpus cæspitosus* L.

47. *Carex scirpoidea* Mx. Abundant on the eastern dome of the mountain.

48. *Carex canescens*, var. *vitilis.* At the very summit of the mountain.

49. *Carex lenticularis* Mx. In the "basin".

50. *Carex rigida* Good. var. *Bigelovii.* On the "narrows", and also in great abundance northwest of the summit.

51. *Carex pulla* Good. ? On the shores of the little lake in the "basin".

52. *Cinna pendula* Trin. Along streams near the mountain.

53. *Calamagrostis Canadensis.* Along the mountain brooks.
54. *Poa laxa*, Hænk. On the "Saddleback".
55. *Aira flexuosa* L. Common.
56. *Hierochloa alpina* R. & S. On the "Saddleback".
57. *Lycopodium Selago* L. Abundant along the "Narrows", etc.
58. *Lycopodium annotinum* var. *pungens.* On the Eastern Ridge.

NOTE.— The foregoing article was written in 1874; the nomenclature therefore conforms to that of the 5th edition of Gray's Manual.— F. L. S.

Knoxville, Tenn.

Noteworthy anatomical and physiological researches.

Observations on the protection of buds in the tropics.[1]

While no little attention has been given to the way in which buds are protected from the cold of rigorous climates it would appear that similar adaptations to guard the delicate parts of plants from the hot and dry atmosphere and the direct rays of the sun in tropical regions have been the occasion of much less study, although this is quite as distinct and considerable a field of research. Treub called attention to the need of such adaptations in 1887, and gave several instances of their occurence. The paper of Potter here summarized is, however, the first to give any satisfactory classification of the various methods employed by different plants, so far as the writer is able to discover. "For the purpose of description," says Potter, "it is convenient to consider these special protective contrivances under four heads," as follows:

1. Protection by means of stipules. 2. Protection by means of gum. 3. Protection by position assumed when young. 4. Protection by shade from older leaves.

Species of Artocarpus, Heptopleurum, Canarium, Wormia and Sarcocephalus are cited as examples of the first class. In all these the stipules form a hood over the young leaves and thus protect them from the too scorching rays of the sun. Of the second class Tabernæmontana is mentioned as particularly interesting. In at least one species of this genus the young leaves develop in a four-sided chamber, the walls of

[1] M. C. POTTER: Journ. Linn. Soc. XXVIII, 343–352.

which are, on two sides, older leaves, and on the other two, thin layers of gum. As an instance of the third case the orthotropic position of folded palm-leaves is mentioned. It would scarcely seem permissible to put forward a case like this as an instance of special adaptation, for, as is well known, it is generally true that rolled-up dorsiventral organs are inclined to take the erect position. Undoubtedly, nevertheless, such a position is of decided value to the young leaves and parts of leaves for it clearly serves to put them in the least exposed position with reference to the incident rays of a hot tropical sun. Many examples of this manner of protection may be found among the monocotyledons in particular. The last method of protection is a favorite one and is by no means confined to plants growing in the tropics. Uvaria, Gossypium and Begonia are the examples cited by Potter. In each of these genera when a leaf has become old enough to resist the hot rays of the sun and the unfavorable conditions of the atmosphere it is quite natural that it should be utilised as a protecting shield for the immature leaves which are less able to withstand conditions varying so widely from the optimum.

Some good figures are given in the plates which accompany the article, and, with the exception of the third, each class is illustrated.—CONWAY MACMILLAN.

Vitality of ferns.

Wittrock publishes in a recent paper[1] a series of observations, which form together a very valuable contribution to the biology of the ferns. It deals especially with the ability of fern-leaves to imbibe water and to become fresh after a long period. Several species are described as showing this power and the author has observed that a special form of the frond is characteristic of each species, when naturally dried. Most interesting, however, is the chapter in which the author demonstrates the ability of the ferns to be revivified after being kept dry for several months or even years and after being preserved as herbarium specimens! Professor Wittrock has taken, for instance, several species from the Pringle-collections immersed them in water for some minutes and then planted them in moist sandy soil, keeping them carefully in shade and under an ordinary glass globe. The ferns became perfectly

[1] V. B. WITTROCK: De filicibus observationes biologicae. Acta horti Bergini, vol. 1. no. 8. Stockholm, 1891.

fresh and developed new leaves and roots, although some had been preserved in herbaria for two years and three months. The Mexican plants which Prof. Wittrock succeeded in reviving were: *Scolopendrium nigripes; Asplenium furcatum, A. Pringlei; Polypodium Plumula, P. lanceolatum; Cheilanthes lendigera, C. Szovitsii; Isoetes Pringlei. Selaginella lepidophylla*, the well-known resurrection-plant, was also cultivated, and specimens which had been kept dry in a jar for more than eleven years revived. The paper is illustrated by five partly colored plates.—THEO. HOLM.

Anatomy of carices.

A very comprehensive study of the anatomical structure of about fifty species of *Carex* has been made by M. Mazel, forming a very welcome addition to the papers which deal with anatomical characters of species. Although the author admits that he has not succeeded in finding any characters in this genus sufficient to characterize the different groups of species, he has at least made a beginning by enumerating a considerable number of peculiarities in the internal structure which undoubtedly may serve in the future as a basis for a more complete study of this genus. It seems, however, that the species selected for examination are not quite sufficient to illustrate the whole genus anatomically. For it must be remembered that we have here to do with an exceedingly large genus, of which the representatives are spread all over the world and living under the most different conditions as to climate and soil. This has not been taken into consideration, and instead of selecting about fifty species, all European excepting one, it would have been more advisable to examine the same number representing other parts of the world. North America posesses very many and most interesting species of *Carex*, which ought not to have been passed by in a "comparative" anatomical study. The Arctic region also has a considerable number of types, many of which appear again farther south, and of which the structure is better suited to illustrate the genus anatomically than a number of species from a relatively small territory. It would also have been highly desirable for the author to give a sketch of the modified structure in the varieties of a few species. This is for in-

ANTOINE MAZEL: Etudes d'anatomie compareé sur les organes de végétation dans le genre Carex. pp. 213 7 plates. Genève 1891.

stance well marked in the different forms of *Carex vulgaris*, *hirta*, etc.

It is a little curious to see that the author considers the character of hairiness as being so very rare in Carex, and that he only mentions this fact for *C. hirta*, while it is also to be found in *C. pallescens*, *pilosa* and many North American species, e. g., *C. virescens*, *castanea*, *aestivalis* and *triceps*.

But otherwise this paper contains many interesting details and proves a skillful and careful research. The first chapter gives a general view of the structure of the vegetative organs, while the second contains a microscopical analysis of the species.

Concerning the leaf-structure the author points out several divergences, taken from the epidermis itself, the stomates, the epidermal expansions, the strength of the stereome, the distribution and shape of the mestome bundles, the reservoirs, etc. Among the reservoirs the author has discovered that those containing tannin are present in several species. He has observed them in the mesophyll, close to the lacunes and just under the epidermis. This is the more interesting since the Cyperaceæ formerly like the Gramineæ and the Ranunculaceæ were considered exceptional in not possessing any reservoirs.[1] The author has, however, not only observed them in the leaf but also in the aerial stem and the rhizome of certain species.

The general structure of the leaf seems to be very uniform, there being a whole series of intermediate forms between the nearly triangular leaf of *C. Davalliana* and the broad and flat leaves of *C. maxima*, *riparia* and others.

There is also given a very detailed account of the tissues in the aerial stem and the rhizome. The aerial shows like the leaf a general plan, which is, however, still more distinct than in the leaf. The epidermis does not show so many differences as in the leaf with its superior and inferior face, and it is rather difficult to observe any essential divergences. It might seem that the sharply triangular stems of several species would furnish reliable characters so as to distinguish them from those in which the stem is nearly terete; but the author calls attention to the fact that the same stem is often not triangular in its whole length.

Among the characters derived from the stem it may be men-

[1] Cfr. SACHS: Vorlesungen über Pflanzenphysiologie 1887, p. 186.

tioned that the mestome-bundles form a different number of rows in certain species, varying from one to four as in *C. Grayii*. The rhizome shows even in its external anatomy a few characteristic differences, if we consider the stoloniferous and cespitose forms. But the internal structure gives still more and very characteristic differences, observable in the stereome, the lacunes, the endodermis, etc. As to the root, the author has observed also here a certain variation. The endodermis and the pericambium does not form a closed ring in all species, but the latter is most often interrupted by the hadrome, as described by Van Tieghem as characteristic for Xyrideæ, Eriocaulaceæ, Juncaceæ and a few other families.

The author is undoubtedly correct, when in the following chapter, where he gives an anatomical sketch of the species in question, he remarks that the characters to some extent may prove to be of specific value, but that it would be impossible from the present study to draw any conclusion as to the mutual relationship of the species described.—THEO. HOLM.

BRIEFER ARTICLES.

Cryptomitrium tenerum Austin.—Mr. O. F. Cook of Syracuse University had the kindness to send me, on my request, a specimen of the above named hepatic, which, being rather imperfectly described by its author, I have undertaken to examine thoroughly, so that the exact systematic position of this very interesting plant may with safety be established. Before going into details as to the relationship of this plant, I give a description of it, as follows:

CRYPTOMITRIUM TENERUM (Hooker) Austin.

Marchantia tenera Hooker in Kunth. Syn. plant. I. p. 45.

Duvalia tenera Gottsche: Synopsis Hepat. p. 554.

Plantae frondosae, terrestres, membranaceae, tenerae, minores, virides, arcte repentes.

Frons oblonga, repetito furcata vel monopodialiter ramosa (furca fertili brevi, altera furca solum increscente). Adsunt etiam rami steriles cum basi angustata ex apice frondis orti vel alii rami adventivi postici e costae latere orti. *Costa* pro plantae tenuitate sat crassa, angusta, in alas sensim attenuata, sub alis evanida, cellulis aequimagnis (corticalibus minoribus) aedificata, *alae* latissimae valde attenuatae, margine tenuissimo unistrato. *Stratum* aëriferum humile, cavernosum; *cavernae* amplae unistratae vacuae i. e. filis vel laminulis acces-

soriis, haud repletae, lamellis unistratis formatae. *Stomata* parum elevata, exigua, cellulis 5–6 radiatis superficialibus constantia, *poro* minimo vel fere nullo, interdum tamen majore cellulisque apice convexo-prominentibus stellaeformi. *Cellulae epidermidis* parvae, haud incrassatae.

Squamae posticae biseriatae, parvae, remotae, purpureae vel violaceae, late ovatae, varie lobatae, lobis superioribus appendiculo filiformi munitis. *Radicellae* incrassatae e basi paginaque squamarum ortae.

Inflorescentia monoica. *Androecia* flori femineo approximata, *antheridiis* in medio costae uniseriatis, saepe totam costae longitudinem occupantibus; *ostiola* conica, pallida. *Pedunculus* capitulorum ex apice costae — strato hypoporo recedente — ortus, basi apiceque nudus, longus, tenuis, bicanaliculatus, irregulariter sulcato-carinatus. *Capitula* feminea circularia, disciformia, antice leniter convexa, 5–6 costata, costae radiatae humiles papulosae, in centro capituli crassae; capitula versus marginem valde attenuata, margine ipso regulariter denseque crenata, postice plana, 5–6 locularia; *loculi* radiatim positi, capituli marginem haud attingentes, involucrati; *involucra* e margine loculorum orta, ovalia, parva, inflata, monogyna, parietibus crassis parenchymaticis, longitudinaliter fissa, labiis conniventibus quasi clausa, tempore maturitatis tenuibus apertis. *Calyptra* tenuis, basi bistrata. *Capsula* sphaerica, vix exserta, bulbo sphaerico affixa, pedunculo subnullo, operculo dehiscens, pariete tenui exannulifera, unistrata. *Elateres* longiusculi bispiri. *Sporae* brunneae, tetraëdrae, reticulatim lamellatae, dilute limbatae.

Hab.— California. Mexico (*Humboldt*).

If we compare this plant with other genera of the order of Marchantiaceæ its close affinity to *Duvalia* is undoubted; it has the same minute stomata, reduced to 5 or 6 conical cells with a very small pore in the center; in both the assimilating stratum consists of a single layer of caverns, which in Duvalia, however, have numerous secondary scales growing out of the walls and sometimes connate to the opposite wall. The postical scales in both genera are very irregularly lobed and dissected, not seldom down to the very base, so that the biseriate arrangement is somewhat obscured. The inflorescence is monoicous in both; in *Duvalia*, however, the male organs, which in Cryptomitrium stand just behind the female peduncle, spring from different branches of the plant; in both the androecia are not pedunculate and the antheridia, as in *Riccia*, are immersed in the substance of the frond; they produce small conical ostiola, which are arranged in a long row; in Duvalia they are united into a small roundish disk and surrounded by minute lanceolate scales.

The female receptacle or capitulum of both genera has a long peduncle, which springs from the end of the costa, being a continuation of the frond, of which the cavernous stratum is left behind (which in *Marchantia*, for instance, is carried up to and may be found in transverse sections of the peduncle on its antical side); in Duvalia this peduncle has but one furrow, in Cryptomitrium two; the female receptacles are very different and justify the separation of Cryptomitrium from Duvalia, being disciform in the former and almost spherical in the latter; the rays of the receptacle in Duvalia are incurved and on the postical side united into a fleshy annulus, which surrounds the end of the peduncle in form of a short vagina, while in Cryptomitrium they are stretched out and united into an uninterrupted plane and fleshy disk; in both genera, however, the involucra spring from the postical side of the substance *between* the rays, contrary to other genera, (*Grimaldia*, *Clevea*. and others) in which the rays themselves are developed into involucra.

There are no perianths and the capsules of both genera open with an operculum. Spores and elaters do not show any material differences.

There could be traced numerous other affinities and distinctions with regard to other Marchantiaceæ; but this would exceed the scope of this article and would involve me in a great many morphological and anatomical details, which I leave to the study of those who read German and are, therefore, able to understand Leitgeb's "Untersuchungen über die Lebermoose," the only scientific work on the development and anatomy of these plants which is very exhaustive, though our plant was not known to its author.— F. Stephani, *Leipzig*.

Pyrus Ioensis.— Professor A. S. Hitchcock tells me that at St. Louis Pyrus Ioensis (see American Garden, xii. 469, Aug. 1891,) is clearly distinct from *P. coronaria*. Among other differences, P. Ioensis holds its fruit longer than the other. He gives me the following note of its fruit: "Fruit about 25 mm. high and 30 mm. in diameter. Peduncle 30 mm. long, with two scars. Apple sunken at each end, where it is pubescent; color green or slightly yellowish. Lenticels rather prominent and numerous. Fruit falling October 26th."— L. H. Bailey, *Cornell University, Ithaca, N. Y.*

EDITORIAL.

An International Congress of Botanists is an exceedingly valuable thing, provided it is really what the name implies. If, however, the real botanists, whom we would delight to honor, stay at home, and we

have let loôse upon us a crowd of quasi-botanists, such a class as is more apt to journey far to congresses than any other, our lines will not have fallen to us in pleasant places. The men we want to visit us are busy, very busy, and are little given to take such long trips for manifestly cosmetic purposes. It would be a phenomenal thing to secure even a fair representation of the real botanists of Europe. There will be great danger, a danger seen lurking around even so conservative a body as our American Association, of confounding a foreign label with one of distinction. The percentage of smatterers and cranks is probably as large in other countries as in the United States, and it is well known that such classes travel further and talk more profusely than any other. We will have to show our good judgment, therefore, not in indiscriminate but in proper recognition.

Nothing would so arouse the active interest of American botanists in this venture as an announcement by the local committee that has the affair in charge, of the names of distinguished foreign botanists who have signified their intention of being present. American botanists will enthusiastically entertain their foreign brethren, and along with the grain will endure a reasonable amount of chaff; but they cannot be expected to endure all chaff. It is not to be expected that the perfunctory invitations of the committee will secure all the desired attendance. These invitations must be supplemented by those urgent private ones sent by acquaintances and correspondents. It is the latter kind that really count. The International Congress will probably be a success if every American botanist will privately urge the attendance of his foreign friends.

If the Congress becomes really representative, its discussions will carry great weight; and any of its decisions with reference to modes of procedure will probably be recognized. If, however, it proves to be a body whose representative character may well be called in question, no such decisions should be promulgated. More important than the nomenclature questions, which, like the poor, we have always with us, are questions of uniform terminology with reference to plant structures, a uniformity that is not so much to avoid confusion of names as confusion of ideas. This will open a vast field of usefulness to the congress, provided always that it is representative, which is to say competent.

OPEN LETTERS.

Suggested by Kuntze's "Revisio Generum Plantarum."

In recent years many changes of well established names have been made solely to satisfy the law of priority, and not owing to any difference in judgment as to generic or specific rank. In some instances this has been carried so far as to abandon long established and household words for names wholly unknown and often inappropriate, because the latter were published a year earlier, or even not any earlier, but simply on the preceding page of the same book, or still logically, say, in the preceding paragraph or line.

When we have objected to calling Nymphæa *Castalia*, or Carya *Hicoria*, or Magnolia grandiflora *M. fœtida*, our mouths have been stopped by the law of priority, and our ruffled tempers have been smoothed by the assurance that all of these vexatious changes were *in the line of stability*, that it would take only a few years to get accustomed to calling Jones *Brown* and Smith *Thompson*, and after the first little inconvenience and strangeness all would settle down into blissful permanency. The mild suggestion that, owing to the different judgments of men and the zeal of future antiquarians we might be simply opening the floodgates to an increased instability, has generally been received by the innovators with bland incredulity. But, to show how the thing really works, now comes along Kuntze with his tremendous *Revisio Generum Plantarum*, and finds it necessary to make 30,000 changes in specific names before he can publish his description of species collected in a journey round the world! Alas, in obedience to the new dictum, or dictator, for he speaks *ex cathedra*, we must no longer call Jones *Brown*, and Smith *Thompson*, but must hereafter call Jones *Baker*, and Smith *Jenkins*. By the irony of fate, we are shown very clearly just how much stability some of the more recent and distressing changes are likely to have. E. g., Nymphæa becomes Leuconymphæa (1737) and Castalia is no more. In the same way Carya becomes Scoria (1808) and Hicoria is shelved. Corydalis becomes Capnodes; Dicentra, Capnorchis; Glaucinium, Mosenthina; Lepidium, Nasturtium; Claytonia, Calandria; Ionidium, Calceolaria, and Calceolaria something else; Elatine, Potamopithys; Oxalis, Acetosella; Pelargonium, Geranospermum; Rhus, Toxicodendron, and so on *ad desperandum*. Even names which have stood more than 150 years, like Liriodendron Tulipifera and Zea Mays have to be converted into Tulipifera Liriodendron and Thalysia Mays to satisfy the ghost of some dead botanist, and the zeal of a live antiquarian.

Old debts become *outlawed* after a time, and it would simplify matters greatly to apply the same practice to old names. There seems almost no end to the changes a persistent rummaging of old literature can bring to light, and we may be certain it will not end with Kuntze. For one, I most devoutly wish the strict law of priority were at the bottom of the sea. It does seem that it would be better to study nature more and parchments less. But the proof of a pudding is said to be the eating, and this closely printed book of a thousand pages is commended to the digestion of Messieurs, the systematists. — Erwin F. Smith, *Washington, D. C.*

NOTES AND NEWS.

A "CONSPECTUS FLORÆ AFRICÆ" is promised by Messrs. Durand of Brussels, and Schinz of Zürich.

THE ENTIRE EDITION of the *Proceedings* of the Society for the Promotion of Agricultural Science for 1891, which was ready for mailing, was burned in the fire at Columbus, Ohio, January 26th. Re-printing the edition has already begun.

MR. C. W. SEELYE, of Rochester, N. Y., has published "A list of the indigenous ferns of the vicinity of Rochester, with notes," a reprint from Proceedings of the Rochester Academy of Science. Of the 53 species of ferns credited to New York state in the Torrey club list, the flora of the vicinity of Rochester contains 35.

A LONG and able article on "Climate and plants" was read by Professor L. H. Pammel before the Iowa Horticultural Society at its meeting in January, 1891, and is published in the Monthly Review of the Iowa Weather Service for October last. It treats the subject from many sides, and contains a wealth of citations.

AMONG the recent bulletins from the experiment stations is one on "Some fungous diseases of the grape" by F. Lamson-Scribner, and one on "Electricity in agriculture" by Clarence D. Warner. The latter has also been published in *Science* for January 15, and is to be commended to those curious in such matters for the utter lack of logical basis for its conclusions.

THE ANNALS OF SCOTTISH NATURAL HISTORY issues its first number with the new year. It is a successor to the *Scottish Naturalist*, and resembles it in form and matter, but is much improved in both, and contains new departments. It is devoted to developing a knowledge of the flora and fauna of Scotland, both recent and fossil. The present number contains 84 pages and two excellent plates. It is a quarterly.

THE UNIVERSITY OF INDIANA has just purchased the entire herbarium of Mr. F. H. Horsford, of Charlotte, Vermont. The collection is very complete in its display of New England and Canadian plants, besides that general assortment of plants which comes into the hands of a collector. The collection is remarkable for the beauty of its specimens, many of them being the handiwork of Mr. Pringle, with whom Mr. Horsford has been so long associated.

THE FOLLOWING botanical papers were presented before the Iowa Academy of Sciences at its December meeting: Some experiments for the purpose of determining the active principles of bread-making, by Miss Minnie Howe; The action of disinfectants on nutrient media, by W. B. Niles; Slime molds of Iowa, by T. H. McBride; Bacteria of milk, Report of committtee on state flora, Phenological notes, and Experiments in prevention of corn smut, by L. H. Pammel.

IN AN EDITORIAL upon the Royal Gardens, Kew, *The Gardener's Chronicle* (Jan. 2) gives an account of its rapid and splendid development since its establishment in 1841, and suggests needed extensions in two directions, viz: a staff of workers to investigate plant diseases, and another for the systematic and coöperative study of the minute anatomy of plants. The suggestion is surely a timely one. It is per-

fectly possible for this great establishment, with its unrivaled opportunities, to become "the center of energy" in many departments.

PROFESSOR WITTROCK gives in a recent paper[1] a very interesting account of the life-history of *Linaria Reverchoni*, a new species collected in Spain. The cotyledons, two or even and quite frequently three, are lanceolate-spathulate, suddenly attenuated towards the apex, which thereby forms like a terminal lobe. There is a long hypocotyl, from the base of which adventitious buds develop and soon grow out, while the main shoot finishes its growth at a very early stage and without any development of either flowers or vegetative buds. The propagation of this species is therefore dependent upon the formation of these adventitious shoots, which are terminated by an inflorescence, besides which they may also branch and often carry a few secondary inflorescences.— T. H.

AGRICULTURAL SCIENCE, founded by Professor C. S. Plumb five years ago, and ably conducted by him up to the close of last year, has been transferred to Professor Wm. Frear of the State College, Pa., who will in future assume the financial and editorial management. Professor Frear has secured the coöperation of sixteen prominent investigators, who will give editorial assistance in the several departments of agricultural activity. Only one of these, Professor F. L. Scribner, is a botanist, and to him is assigned the duty of looking after "botany and mycology," according to the prospectus. The "and" in that triplet of words is a pretty sure indication that the management is not especially familiar with the several departments of botany, and probably does not appreciate its present scope or its importance as a science underlying a large proportion of agricultural operations. The journal has occupied an important place in the past; and it deserves hearty support under the new relations.

PROFESSOR LESTER F. WARD'S paper on "Principles and methods of geologic correlations by means of fossil plants," read before Section E of the A. A. A. S., Washington meeting, is printed in the *American Geologist* (Jan.). Of course it is a strong putting forward of the claims of paleobotany by one of its most competent exponents; but a point of special interest to botanists is the retort made by the author to the general botanical accusation of paucity of material and uncertainty of results. Stating that paleobotany has added not a little to our knowledge of botany proper, the author proceeds to say: "For example, it is the habit of botanists to figure leaves so carelessly that the paleobotanist is unable to tell the genera to which they belong. This is chiefly due to the fact that they ignore, as a rule, the exact nervation of leaves, and are content to figure them almost from the standpoint of the artist, merely for the sake of the effect. Paleobotany has taught the botanists that the nervation of leaves is important, and that wherever possible it should be carefully figured. We are indebted to fossil plants for the discovery that nervation in leaves is of generic rank, whereas form, upon which the botanist chiefly relies, is usually only of specific rank." Botanists must confess to myriads of figures of leaves, in which the nervation is merely conventional.

[1] *De Linaria Reverchoni* n. sp. observations morphologicae et biologicae. Acta horti Bergiani, vol. 1. no. 4, Stockholm, 1891.

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